

AD 629767

PICATINNY ARSENAL

DOVER, NEW JERSEY



Code 1

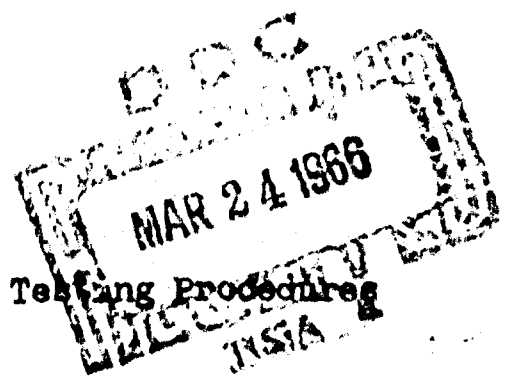
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TESTING MANUAL

PROCESSING COPY

SUBJECT:

Fragmentation Testing Procedures



P. A. MANUAL NO. 5-1

DATE 24 August 1950

COPY NO. 19

PICATINNY ARSENAL

Dover

New Jersey

Testing Manual

Subject: Fragmentation Testing Procedures

P. A. Manual No. 5-1

Date: 24 August 1950

Purpose of Test

→ A fragmentation test consists of static functioning the explosive filler of a projectile, rocket, bomb, mine, etc, for the purpose of determining the number and weight groupings of the recovered fragments.

A fragmentation test may be conducted to determine the efficiency of an explosive, projectile, rocket, mine, bomb, etc or any of its components.

Description of Test

There are four general types of fragmentation tests, which are:

1. Closed Chamber or Pit Tests
2. Open Pit
3. Panel Test
4. Velocity Measurement Test

→ This manual describes standard techniques for conducting a fragmentation test of an HE-loaded item in a closed chamber or pit.* A pit fragmentation test is conducted to determine the average mass distribution for the entire item without regard for local origin of fragments. All fragments are collected insofar as possible for study of weight, number, and the size of the ~~Material~~ fragments produced. The fragmentation chamber is an expensive piece of equipment, therefore, it shall not be used for the testing of explosives greater in power than 8 or 16 pounds of Composition B in sawdust or sand, respectively. ↗

Criteria for Passing Test

No rigid criteria can be imposed upon the acceptability of the results of a fragmentation test (except where specification requirements apply). In some instances it is just as undesirable to obtain one or two fragments from an item as it is to obtain thousands of fine particles. It is desirable to obtain as many "effective" fragments as possible. The size of "effective" fragments is determined by the target against which the item is to be used. Thus, an armor piercing projectile should ideally produce all group 3** fragments, while a HE Projectile should produce the majority of fragments in groups 1 and 2. For HE Projectiles 85% to 99% of the weight of the projectile should be recovered. A 100% or more recovery should be questioned, normally disregarded, and a retest conducted. However, before conducting the retest, the material should be completely resifted or replaced with clean material. Specifications covering projectiles, rockets, mines, grenades, etc, manufactured from cast iron, plastic, ceramic, etc, may indicate the percent of recovery acceptable, which in some instances may be very low.

*The other types of tests noted are performed at Aberdeen Proving Ground and described in Ordnance Proof Manual No. 40-23.

**"Group" (See "Test Procedure")

Equipment

This Arsenal is equipped to perform the closed chamber test. Two buildings (Nos. 607 and 621), embracing essentially the same fragmentation equipment, are located in the 600 area of the Testing Section.

The fragmentation "tubs" (See attached schematic drawing) in the two fragmentation buildings are 15.4 feet in diameter and 14.75 feet deep. The lower portion of the tub is cone-shaped, 15.3 feet diameter at the top, tapering to an opening of 13 inches at the bottom. The height of the cone is 7.3 feet. The bottom opening is fitted with a valve which controls the flow of material onto a gyrosifter recovery screen. When sand is used the sifter is fitted with a No. 4 Screen, having square openings of .170 inch and is used for all Projectiles over 20 mm. A No. 8 Screen having square openings of .084 inch is used for 20 mm Shell and for special tests of larger shell. Equipment is available, if necessary, to fragment 20 mm projectile in a small tub.

A magnetic separator has been designed and installed in the fragmentation building. This separator will insure the recovery of fragments that previously were too small to be retained on the gyrosifter recovery screen. A screen fitted on the gyrosifter may have larger openings than the No. 4 or 8 screen when a magnetic sifter is used.

Test Procedure

The following information will be available before tests are conducted:

1. Identity of component.
2. Lct number, if any.
3. Weight data (empty and loaded).
4. Type of explosive filler.
5. Test directive.

A fuze modified for electrical ignition is used to function the HE fillers of the unit being fragmented. All projectiles except as directed, are fitted with a fuze modified for static functioning as shown on Drawing PX 97-287. Other fuzes will be modified for static firing with a No. 8 Electric Blasting Cap positioned on the Booster Lead unless otherwise requested in test directive.

A soft wood box of internal dimensions equal to three times the diameter of the projectile manufactured from 1/2-inch-thick wood (Table I), is then placed on end in the sand. The depth of the sand or sawdust is adjusted to the size of the projectile being tested. (Table I) The projectile is set on its base in the center of the box and no bracing is used except when the design of the projectile requires a support to hold it in an upright position. The fuze is then fitted to the projectile. After the fuze is fitted to the item secure the top of the box in place with two

small nails. The top should be fastened securely enough to the box to prevent the material from seeping into the inside of the box. The box is then covered with sand to the depth required for the caliber of projectile or item being fragmented. Care should be exercised in this operation so that the material does not break or displace the box. This can be accomplished by limiting the flow of the material from the storage hopper. Care should be exercised to insure that the shell remains upright in the box and electric leads are not damaged after it is covered with sand or sawdust.

The fragments are recovered and classified by weighing and grouping according to the following weight zones:

<u>Group</u>	<u>Grains</u>
0	0 to 75
1	75 to 150
2	150 to 750
3	750 to 2500
4	2500 and over

Upon special request, the fragments are further sub-divided as follows:

<u>Shell Caliber</u>	<u>Sub-Grouping</u>
20 mm to 57 mm, incl	0 to 25 grains 25 to 50 grains 50 to 75 grains
All larger than 57 mm	0 to 50 grains 50 to 75 grains

After weighing and classifying the fragments, they are photographed, (attached are typical photographs of recovered fragments) in accordance with Table No. II. By maintaining the lay-out size pertinent to projectile size, all photographs can be compared visually. Attached are photographs illustrating the equipment used in photographing the fragments.

Safety Precautions

The following Safety Procedures must be adhered to in conducting a Fragmentation Test.

1. The Ammunition Tester who "plants" the projectile will retain possession of the key used for locking the electric firing line switch in the "off" position.
2. Only one projectile will be taken into the Fragmentation Building at a time.

3. The fuze modified for ignition with an electric blasting cap will be assembled to the projectile after the projectile is placed in the box in the fragmentation tub.

4. After making sure that the firing line plug is disconnected from the wall receptacle, the lead wires of the electrical blasting cap will be connected to the end of the firing line.

5. After covering the box with recovery material (sand or sawdust) make sure that the firing line switch is open (if the red light at the receptacle is lit don't insert the firing line plug until the main firing line switch is opened) then insert the firing line plug into the wall receptacle.

6. All personnel will evacuate the building. Not less than 2 nor more than 6 people will be present in the building when a loaded projectile is present.

7. Functioning of the projectile charge will be accomplished by manipulating the electrical switch located outside the building.

8. After functioning the projectile, personnel equipped with respirators may re-enter and begin recovery operations after gases have dispersed. All fragments retained on the screen or in the magnetic recovery box will be recovered. Also, all wood or other material will be examined, and imbedded fragments, if found, will be recovered.

9. All misfires or malfunctionings will be reported to the foreman before any personnel re-enter the building. In case of a misfire all personnel will wait not less than 1/2 hour before re-entering the building. Duds resulting from misfires will be recovered in accordance with procedures furnished by the Safety and Security Division.

10. Sawdust will be fireproofed by spraying with the following solution composed of:

Borax	7 parts by weight
Boric Acid	3 " " "
Diammonium	
Phosphate	5 " " "
Water	85 " " "

The sawdust should be allowed to dry before using to eliminate the excessive steaming due to the presence of water.

References

Ordnance Proof Manual No. 40-23; Ord-M608-PM, Subject: Fragmentation Test for Bombs and Projectiles (P.A. Library)

O.O. Development Test and Evaluation Procedure Manual for Bomb, Bomb Fuzes, Pyrotechnics, etc, Published by Munitions Board Aircraft Committee (P.A. Library).

Fragmentation Data on Bomb and Projectiles, Bureau of Ordnance Publication 2 April 1949, OP 1458 (P.A. Library).

P.A. Technical Division Fragmentation Test Record No. 207 (P.A. Library)

Drawings covering the fragmentation equipment and buildings are filed in Engineering Division.

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PICATINNY: ARSENAL FRAGMENTATION TEST

RESULTS

TEST RECORD NO. 99

DATE 24 August 1950

Shell No.	Wt. Empty Lbs.	Wt. Loaded Lbs.	Number and Weight of Recovered Fragments												Percent of Fragments Recovered	Photo No.	Sp. Gr. of Charge
			No. 0 Group 0 to 75 Grs.		No. 1 Group 75 to 150 Grs.		No. 2 Group 150 to 750 Grs.		No. 3 Group 750 - 2500 Grs.		No. 4 Group 2500 Grs., over		Total				
			No.	Wt. Lbs.	No.	Wt. Lbs.	No.	Wt. Lbs.	No.	Wt. Lbs.	No.	Wt. Lbs.	No.	Wt. Lbs.			
I-44	9.13	10.06	341	1.15	82	1.33	117	5.26	5	.61	1	.57	546	8.92	76.6	N-XXXX	

TABLE NO. I

<u>Projectile Size</u>	<u>Size of Container</u>	Approx. quantity of Sand* Used (in feet)	
		<u>Below Box</u>	<u>Above Box</u>
20 mm	Usually cardboard Container (Quart size)	2	3
37 mm	8 x 8 x 8 x 1/2 wood box	2	3
40 mm	8 x 8 x 8 x 1/2 wood box	3	4
Hand Grenade	6-3/4 x 6-3/4 x 13-1/2 x 1/2 wood box	3	4
57 mm	8 x 8 x 12 x 1/2 wood box	3	4
60 mm	8 x 8 x 12 x 1/2 wood box	3	4
65 mm	8 x 8 x 14 x 1/2 wood box	5	6
75 mm	8 x 8 x 14 x 1/2 wood box	5	6
81 mm	8 x 8 x 14 x 1/2 wood box	5	6
3 inch	8 x 8 x 14 x 1/2 wood box	5	6
20 lb Bomb	10 x 10 x 20 x 1/2 wood box	6	7
90 mm	10 x 10 x 20 x 1/2 wood box	6	7
105 mm	10 x 10 x 20 x 1/2 wood box	6	7
120 mm	12 x 12 x 30 x 1/2 wood box	7	8
155 mm	12 x 12 x 30 x 1/2 wood box	7	8
5 inch	12 x 12 x 30 x 1/2 wood box	7	8
6 inch	12 x 12 x 30 x 1/2 wood box	7	8
4.5 in. Rocket	12 x 12 x 36 x 1/2 wood box	7	8

*Quantities of sawdust may require double the quantities noted for sand.

TABLE II

The table size noted pertain to tables shown on attached photographs.

<u>Projectile Size</u>	<u>Width (Inches)</u>	<u>Length (Inches)</u>	<u>Size of Table</u>
20 mm	5-1/2	8	Very small glass plate
37 mm	12	18	small
40 mm	13	18	small
57 mm	15	19	small
60 mm	14	21	small
75 mm	24	33	small
3 inch	20	30	small
81 mm (M43)	18-1/2	27	small
81 mm (M56)	26	38	small
90 mm (APC)	27	40	large
90 mm	26	39	large
105 mm	31	46	large
4.5 inch	34	51	large
4.2 inch	31	50	large
120 mm (4.7 in.)	36	44	large
155 mm (APC)	33	46	large
155 mm	40-1/2	60	large
Destructor	9-1/2	12	small
Hand Grenade	11-1/2	19-1/2	small
20 lb Bomb	27	42	large
AP mine	16	25	small
4 lb Bomb	10	18	small
4.5 in. Rocket	36	54	large



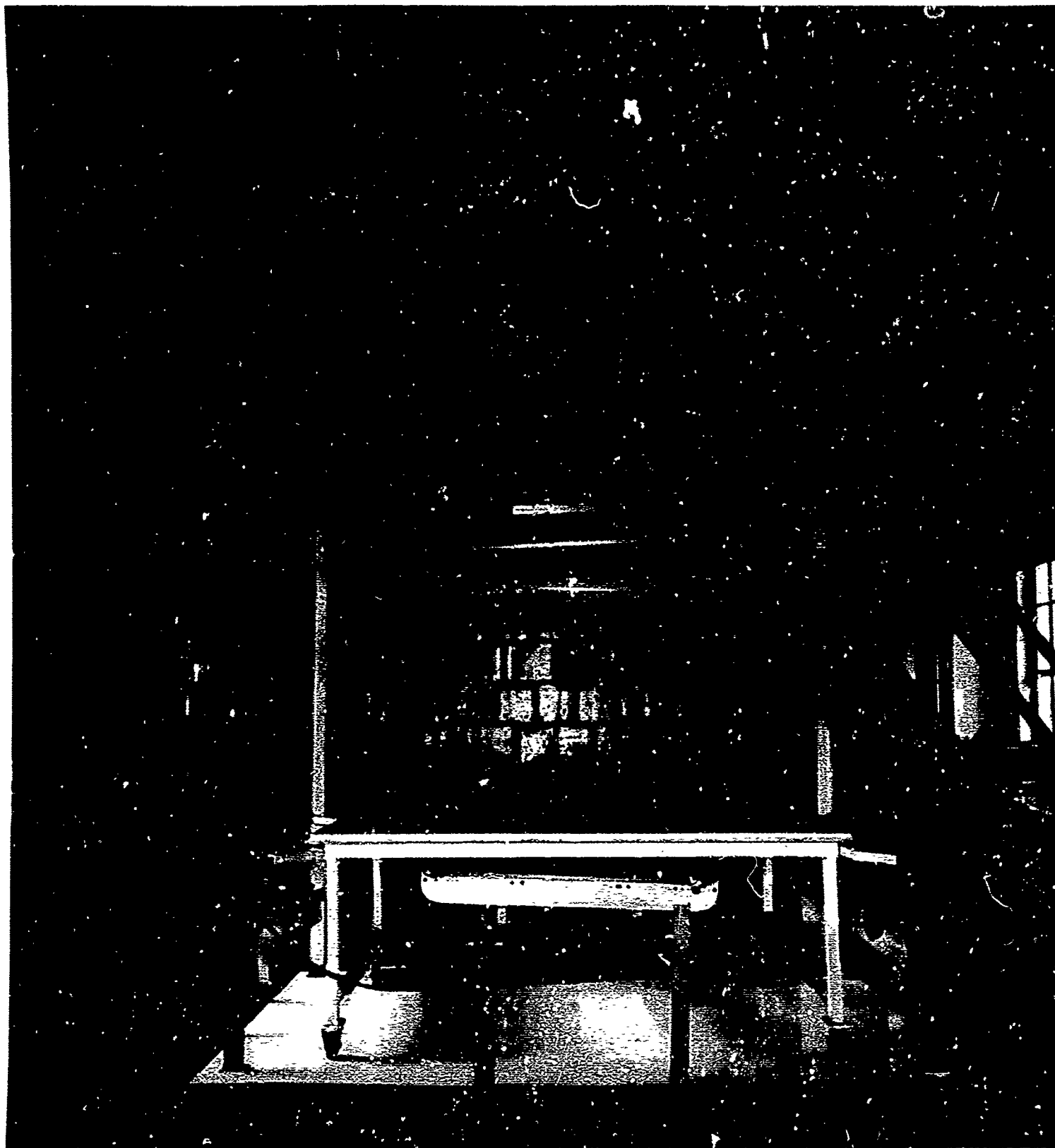
M-38315

November 1950

PICATINNY ARSENAL

ORDNANCE CORPS

Bldg. No. 621 - Modern Fragmentation Bldg.



M-36309

December 1949

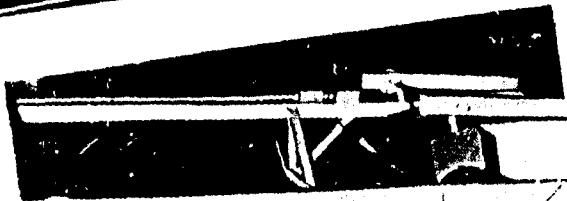
PICATINNY ARSENAL

ORDNANCE DEPARTMENT.

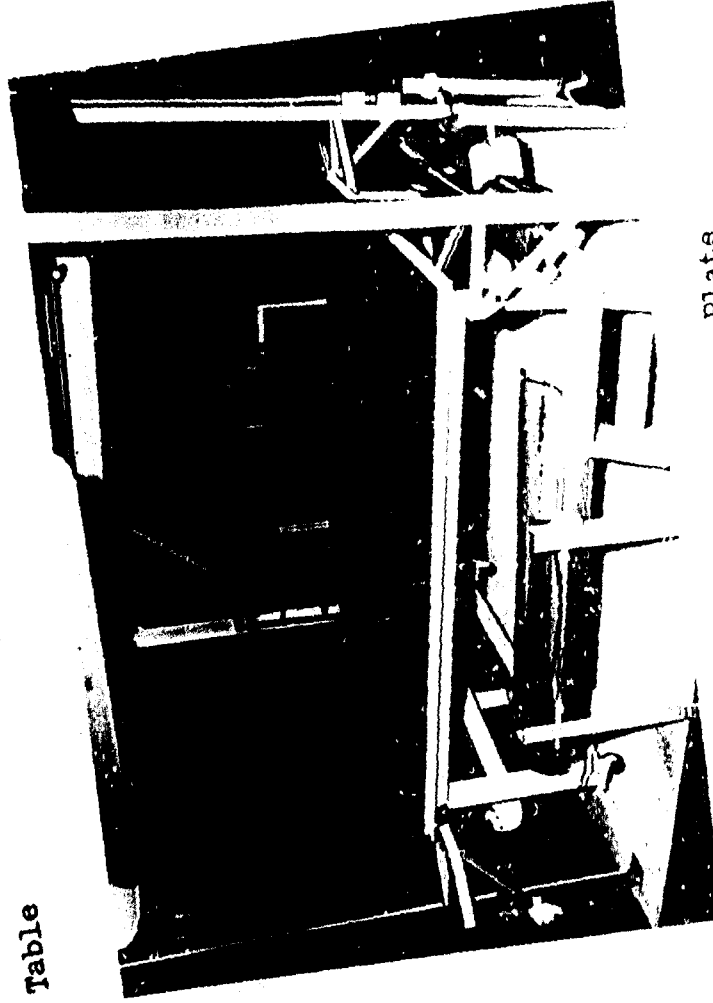
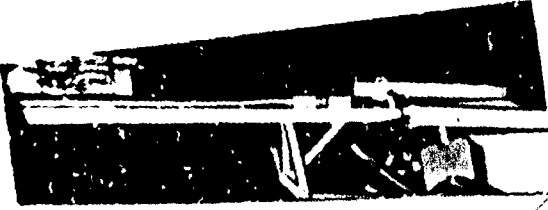
Equipment for Photographing Fragments, Resulting
from Functioning Test.



Large Table



Small Table



Small Glass Plate

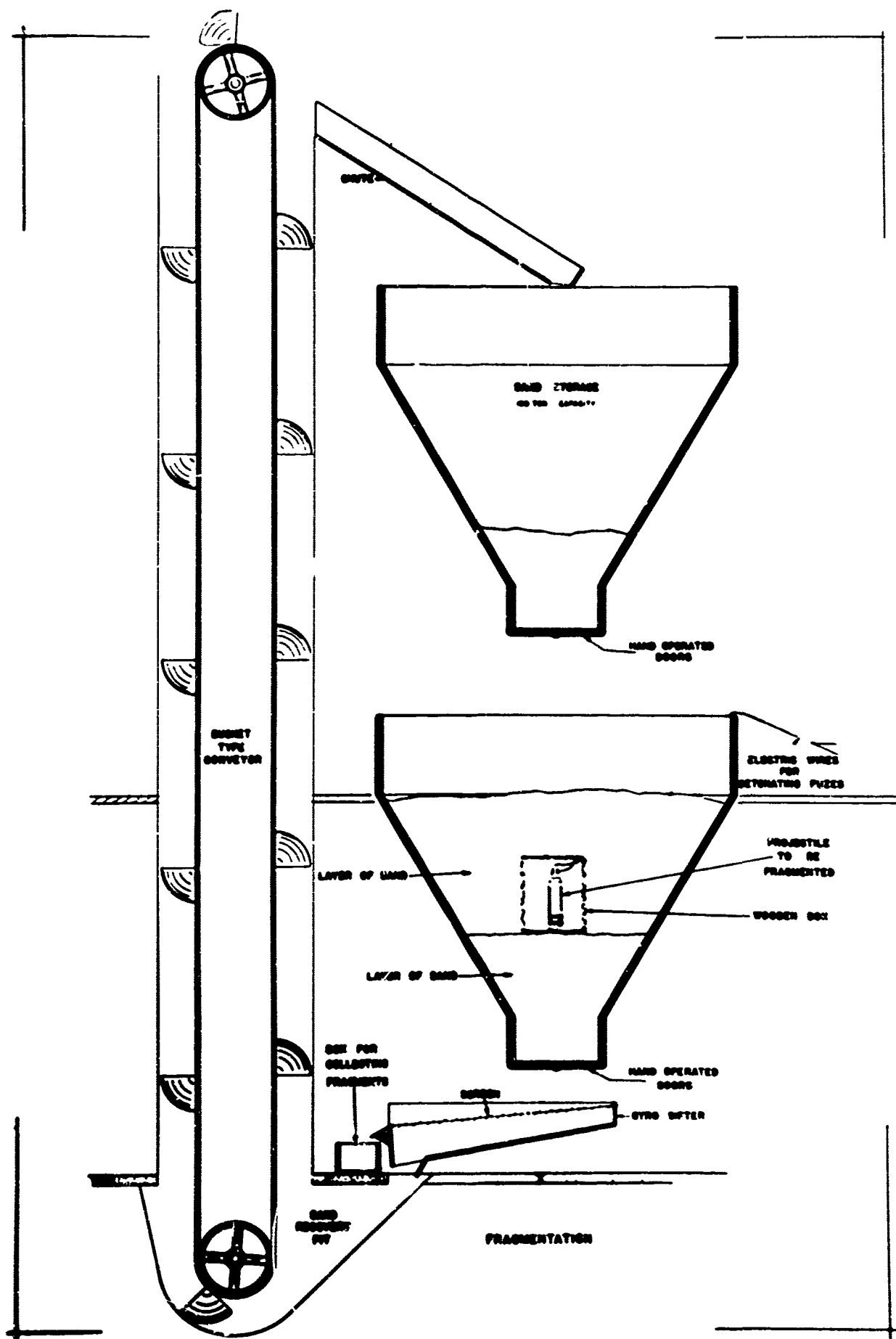
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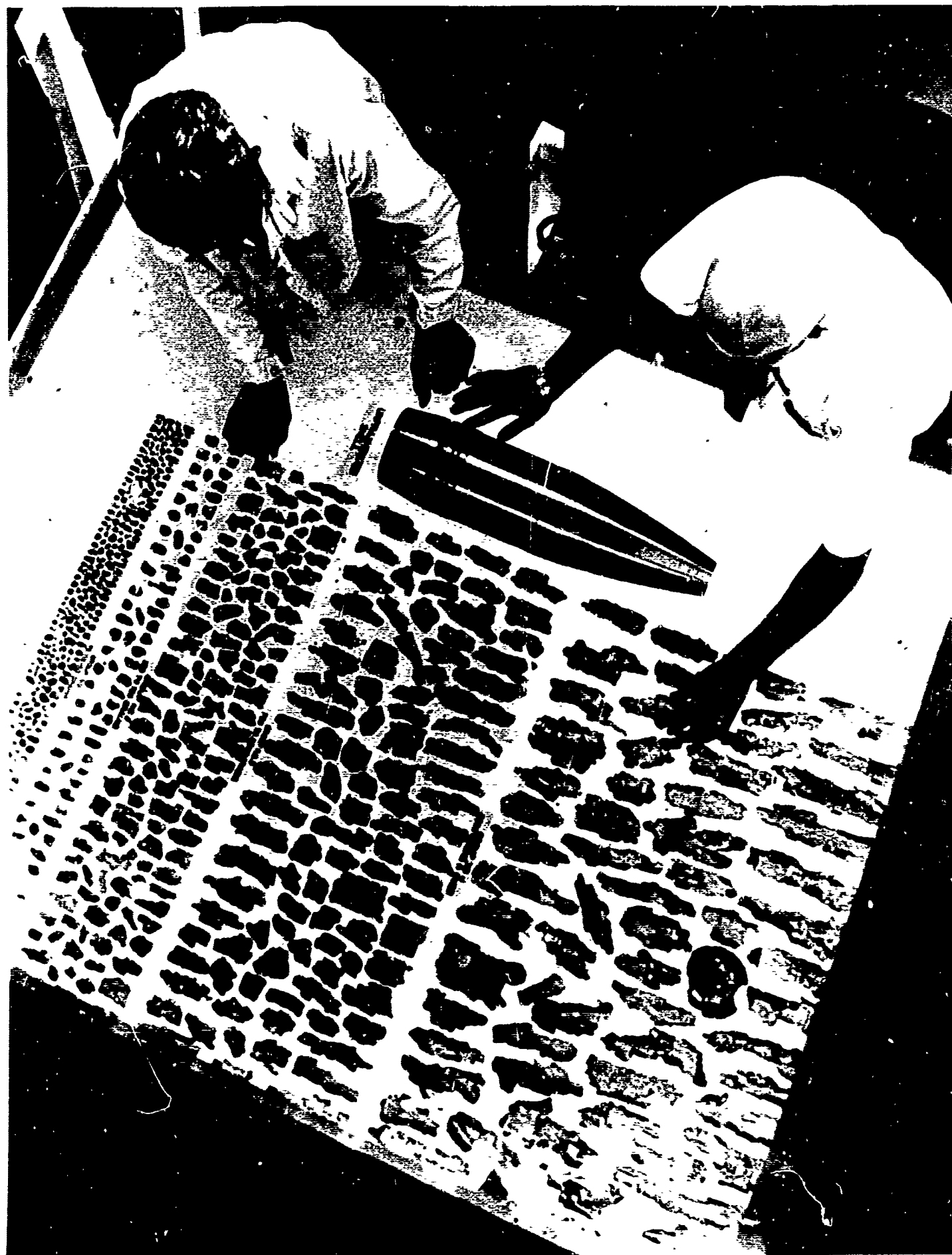
(Noted in Table 11).

PICATINNY ARSENAL
July 1950
Equipment for Photographing Fragments.

M-37320/1









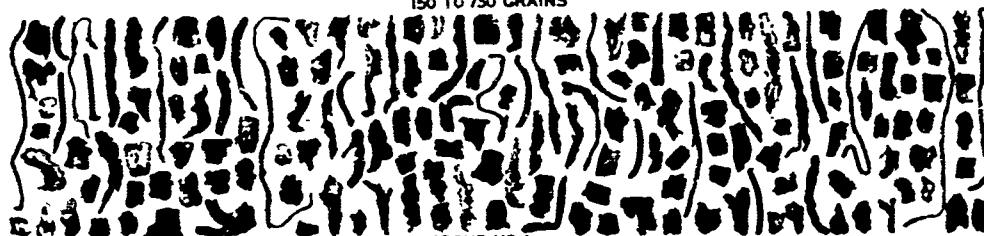
GROUP NO 4
2500 GRAINS & OVER



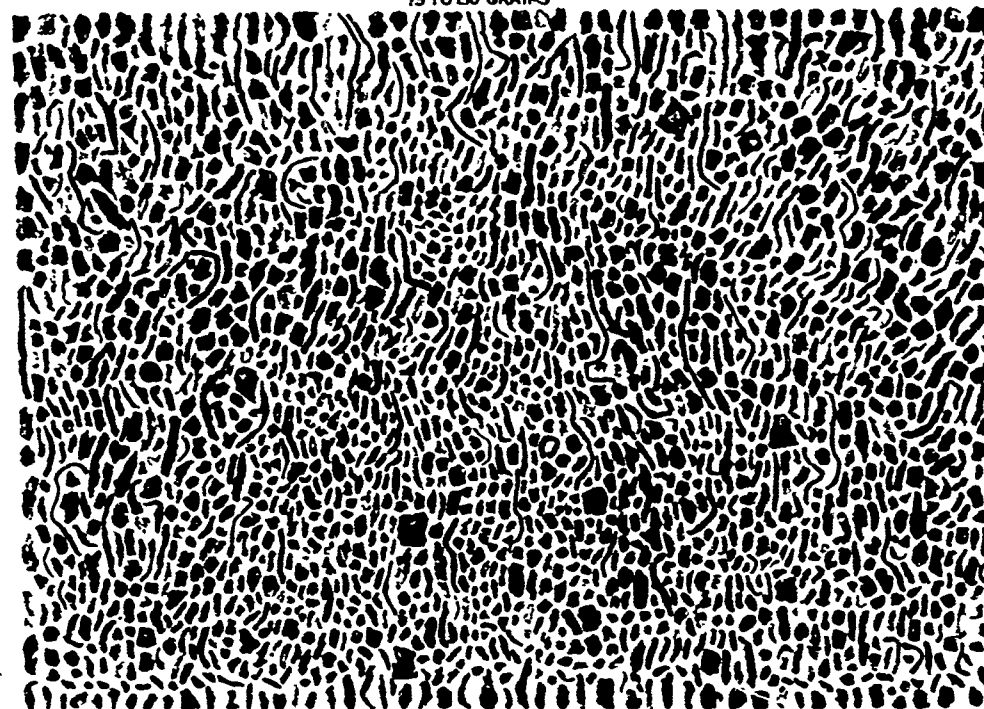
GROUP NO 3
750 TO 2500 GRAINS



GROUP NO 2
150 TO 750 GRAINS



GROUP NO 1
75 TO 150 GRAINS



GROUP NO 0
0 TO 75 GRAINS



UNFRAGMENTED
ROCKET

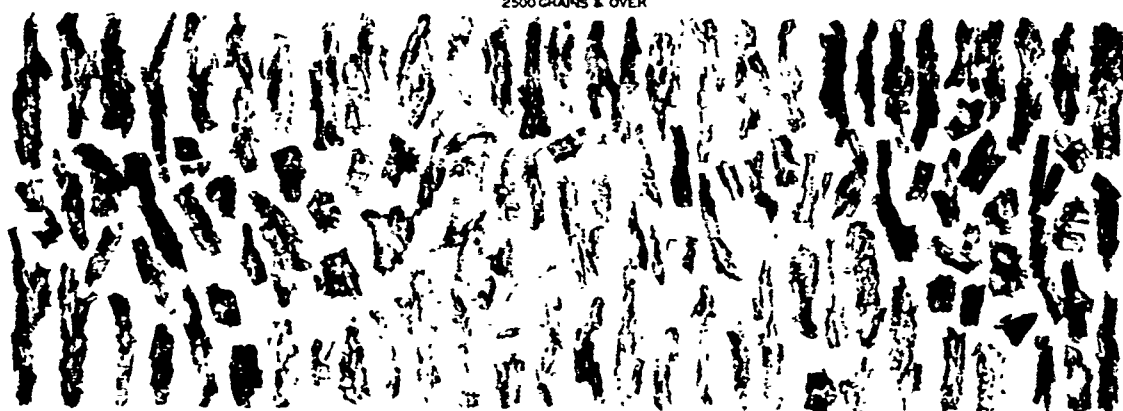
ORDNANCE DEPARTMENT PICATINNY ARSENAL
ROCKET P.P.4 INCH M8
P.A. FRAG RECORD NO. 91
SHELL NO. 1 OCT. 1942 M-14697
X418



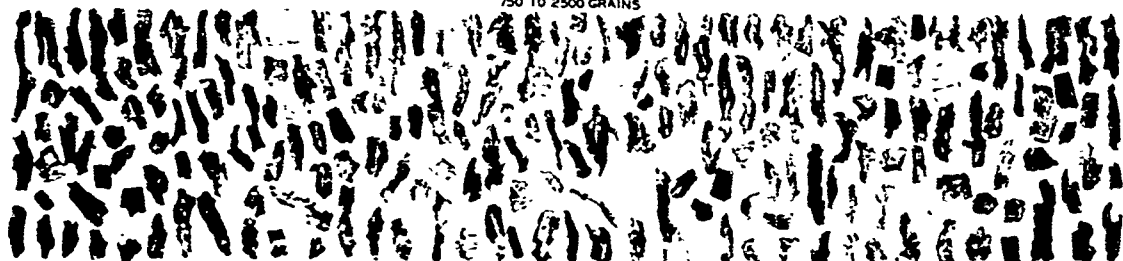
U. FRAGMENTED
SHELL



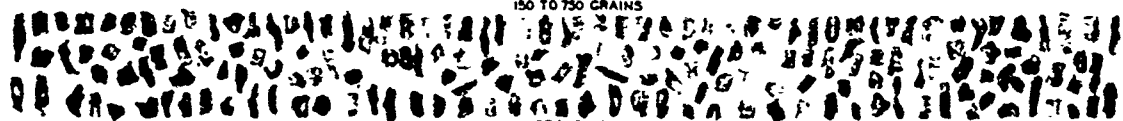
GROUP NO 4
2500 GRAINS & OVER



GROUP NO 3
750 TO 2500 GRAINS



GROUP NO 2
150 TO 750 GRAINS



GROUP NO 1
75 TO 150 GRAINS



GROUP NO 0
0 TO 75 GRAINS

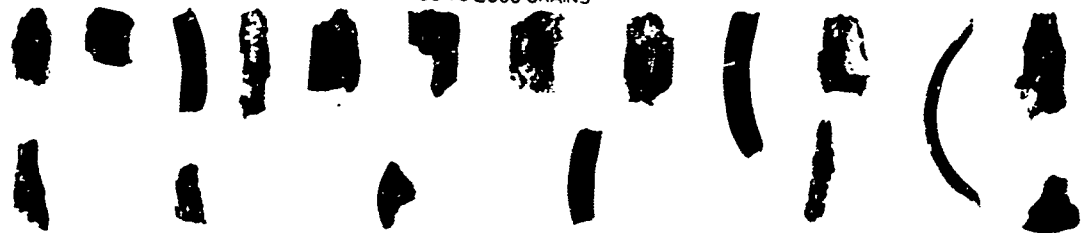
ORDNANCE DEPARTMENT
FICATINNY ARSENAL
155MM H.E. SHELL M101
PA FRAG RECORD NO115
SHELL NO 1 MAR 1943 M-15887



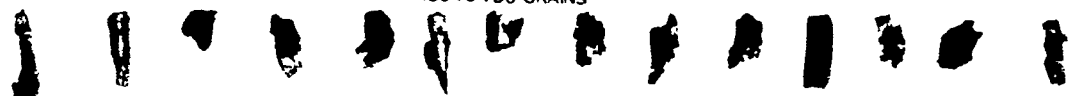
GROUP NO. 4
2500 GRAINS & OVER



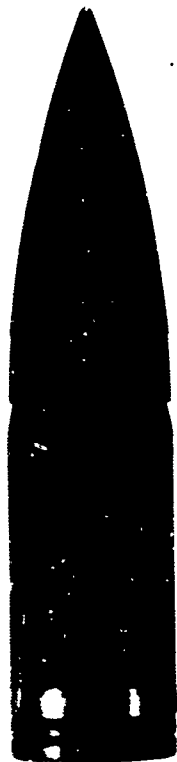
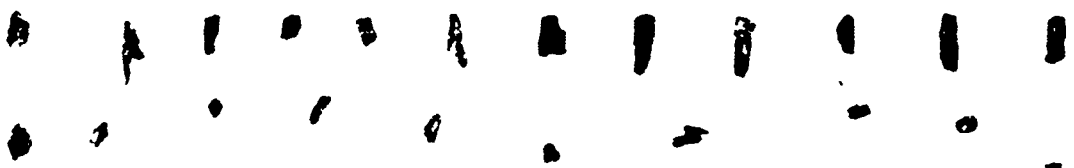
GROUP NO. 3
750 TO 2500 GRAINS



GROUP NO. 2
150 TO 750 GRAINS



GROUP NO. 1
75 TO 150 GRAINS



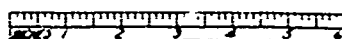
UNFRAGMENTED
PROJECTILE



UNFRAGMENTED
FUZE



GROUP NO. 0
0 TO 75 GRAINS



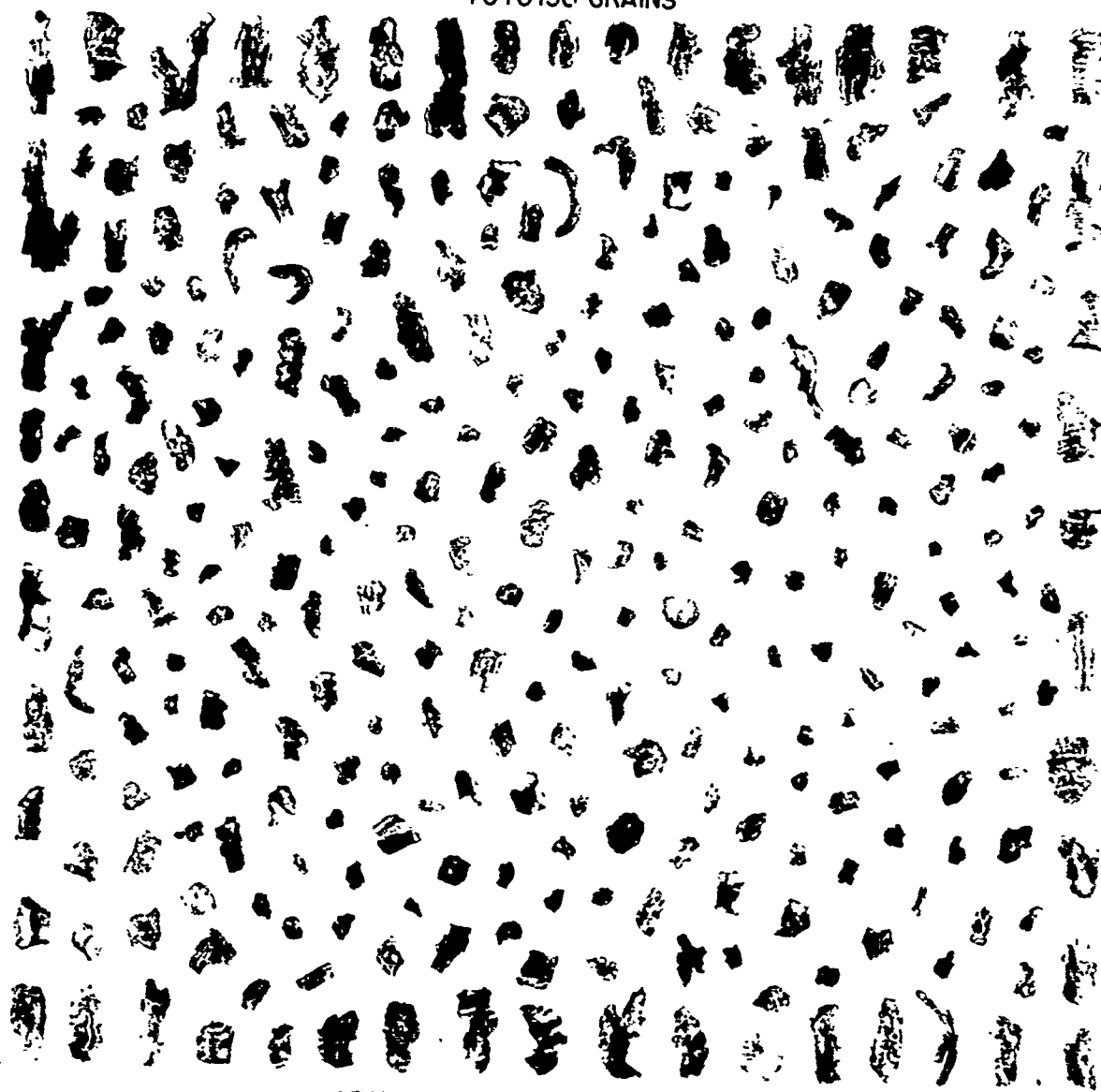
ORDNANCE DEPARTMENT PICATINNY ARSENAL
75MM. A.P.C. PROJECTILE M61
PROJECTILE NO.2 MAR. 1943 M-16056



GROUP NO. 2
150 TO 750 GRAINS



GROUP NO. 1
75 TO 150 GRAINS



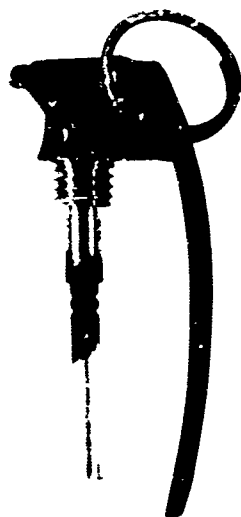
UNFRAGMENTED
SHELL

GROUP NO. 0
0 TO 75 GRAINS



ORDNANCE DEPARTMENT PICATINNY ARSENAL
60MM H.E. SHELL, M49A2
P A FRAG. RECORD NO 178
SHELL NO. 1 JAN. 1944

M-20423



T2 FUZE



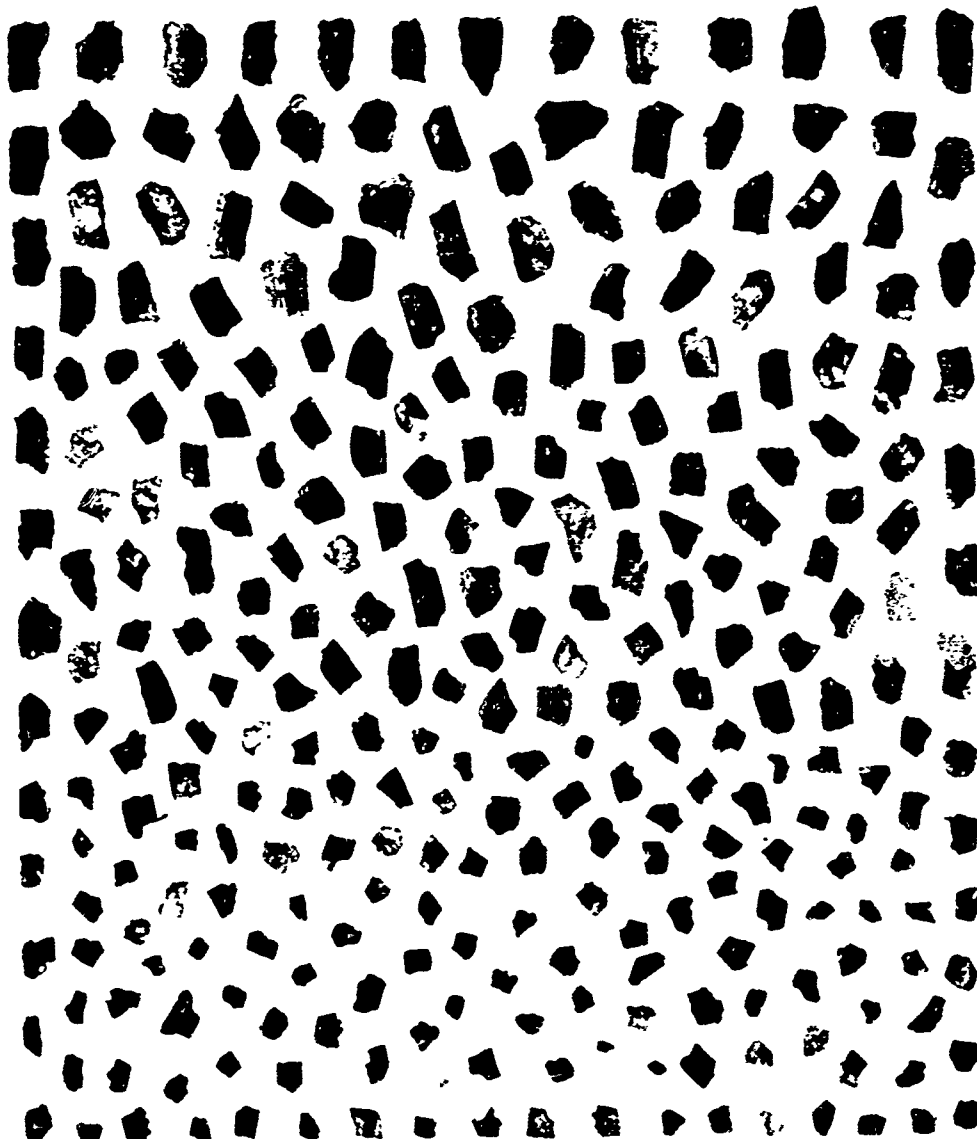
UNFRAGMENTED
GRENADE



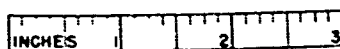
GROUP 2
150 TO 750 GRAINS



GROUP 1
75 TO 150 GRAINS



GROUP 0
0 TO 75 GRAINS



ORDNANCE DEPARTMENT PICATINNY ARSENAL
GRENADE, HAND, FRAGMENTATION MKII FROM
SEMLER CO., WITH T2 FUZE
GRENADE NO 2 MAY 1944

M-22303